

15. (a) Expand $\cos 6\theta$ in terms of $\sin \theta$.

Or

- (b) If $\frac{\sin x}{x} = \frac{863}{864}$, find an approximation value of x .

SECTION C — ($3 \times 10 = 30$ marks)

Answer any THREE questions.

16. Show that

$$\frac{1}{1 \cdot 2 \cdot 3} + \frac{1}{3 \cdot 4 \cdot 5} + \frac{1}{5 \cdot 6 \cdot 7} + \dots \infty = \log 2 - \frac{1}{2}.$$

17. Find by Newton's method an approximate value of the positive root of equation $x^3 - 6x + 4 = 0$.

18. Find the eigen values and eigen vectors of

$$\begin{pmatrix} 2 & 2 & 0 \\ 2 & 1 & 1 \\ -7 & 2 & -3 \end{pmatrix}.$$

19. Using Cramer's rules, show $x = 2y + 3z = 9$, $3x + y - z = 2$, $2x - 3y + 2z = 5$.

20. Trace that $16 \sin^5 Q = \sin 5\theta - 5 \sin 3\theta + 10 \sin \theta$.

NOVEMBER/DECEMBER 2025

CAEL12/FAEL12 — BASIC MATHEMATICS I

Time : Three hours

Maximum : 75 marks

SECTION A — ($10 \times 2 = 20$ marks)

Answer ALL questions.

- Prove that $\frac{e-1}{e+1} = \frac{\frac{1}{L^2} + \frac{1}{L^4} + \frac{1}{L^6} + \dots \infty}{\frac{1}{L^1} + \frac{1}{L^3} + \frac{1}{L^5} + \dots \infty}$
- If $y = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \dots \infty$ show that $x = y + \frac{y^2}{L^2} + \frac{y^3}{L^3} + \dots \infty$.
- Define Reciprocal equation.
- If α, β, γ are the roots of the equation $ax^3 + bx^2 + cx + d = 0$ find the equation whose roots are $\alpha^2, \beta^2, \gamma^2$.
- Prove that the matrix $\begin{bmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{bmatrix}$ is orthogonal.



6. Find the sum and product of all the eigen values

of the matrix $\begin{bmatrix} 1 & 2 & -2 \\ 1 & 0 & 3 \\ -2 & -1 & -3 \end{bmatrix}$.

7. Compute $A+B$ and $A-B$, given that

$A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 3 & 0 \\ -1 & 2 & 5 \end{bmatrix}$.

8. Define identify matrix with example.

9. Expand $\tan 7\theta$ in terms of $\tan \theta$.

10. Evaluate $\lim_{x \rightarrow 0} \frac{\tan 2x - 2 \tan x}{x^3}$.

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) Resolve into partial fractions

$$\frac{2x+3}{(x-1)(x-2)(x-3)}.$$

Or

- (b) Find the sum to infinity of the series

$$1 + \frac{1+2}{L^2} + \frac{1+2+2^2}{L^3} + \dots \infty.$$

12. (a) Solve the equation

$$4x^4 + 20x^3 + 33x^2 - 20x + 4 = 0.$$

Or

- (b) Increase by 7 the roots of the equation

$$3x^4 + 7x^3 - 15x^2 + x - 2 = 0.$$

13. (a) Express $\begin{bmatrix} 6 & 8 & 5 \\ 4 & 2 & 3 \\ 9 & 7 & 1 \end{bmatrix}$ as the sum of a

symmetric and a skew symmetric.

Or

- (b) Verify Cayley-Hamilton for the matrix

$$\begin{pmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{pmatrix}.$$

14. (a) Find the adjoint and inverse of $A = \begin{bmatrix} 4 & 7 \\ 2 & 6 \end{bmatrix}$.

Or

- (b) Show that $\det(AB) = \det(A) \cdot \det(B)$ for

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}, B = \begin{bmatrix} 0 & 1 \\ 2 & 3 \end{bmatrix}.$$

